### Troubleshooting & Specs

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All Sentinel Timers and controllers offer a 3-year warranty.

Ask your retailer for details.

Sentinel products are distributed by:

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www.growgps.com
Welcome to the future... Controlling temperature and CO₂ PPM levels has never been easier. The CTC-1 combines an accurate digital temperature sensor and a state of the art NDIR CO₂ sensor in one reliable and easy to use controller. By controlling supplemental CO₂ with PPM (part-per-million) accuracy, plant growth can be accelerated by as much as 30%.

The CTC-1 has been designed to maintain a specific temperature and CO₂ level within an area. It can operate any 120 volt CO₂ device and any 120 volt cooling or heating device.

There are multiple modes of operation that allow it’s use for more than one application.

Because of it’s built-in flexibility, the CTC-1 is equally at home controlling a variety of agricultural applications OR controlling a mushroom farming operation.

Agricultural applications involve increasing the CO₂ level to between 1000 and 1500 PPM by using either compressed CO₂ or operating a combustible gas CO₂ generator.

Mushroom farmers need to reduce the CO₂ level because mushrooms produce CO₂. An exhaust fan can be connected to the CTC-1 to keep the CO₂ level at the desired level.

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**Troubleshooting & Specs**

**Problem: The unit does not power up at all.**
Check and reset the circuit breaker. A small red button will pop out at the bottom of the unit, press it in to reset. If the problem continues, reduce the number of devices connected to the unit.

**Problem: The CO₂ outlet does not turn on.**
1) There are different modes that can be selected. Refer to Page 6 to fully understand how the modes affect the CO₂ function.
2) The Photocell on the front face may affect the CO₂ function. If it is selected to operate, during the Day, ensure the photocell is receiving enough light to activate it. (Green LED will be ON)

**Problem: The CO₂ reading does not seem to be accurate.**
A quick check of the calibration of the CO₂ sensor can be performed. Refer to page #9 to check and recalibrate the sensor.

**Problem: The unit reads “Warm Up” for more than 10 minutes.**
Turn the power switch Off for 5 seconds, then turn the switch On. After 10 minutes, the unit should complete the start-up and begin to display the temp and CO₂. If it does not, contact the factory.

**Problem: The device I have connected to the Temperature receptacle, cycles On & Off too much.**
The CO₂ and temperature deadband can be increased to reduce cycling of the device. Refer to setting dead bands on page #7

**Problem: The unit does seem to react as quickly to changes.**
The internal fan is designed to draw in through the bottom and out the top on the enclosure. The internal sensors then sense the air flowing across them. If the vents in the bottom or top of the enclosure are blocked, the unit may not react as quickly to changes. Disconnect the unit and use low pressure compressed air to blow out any debris accumulated in the vent areas.

**Problem: I would like to return the unit to is default settings.**
The Restore Factory Setpoints button will allow the unit to be returned to it’s original state. Only use this function if all other attempts to resolve an issue have failed.

*Note: you may need to recalibrate the CO₂ sensor Refer to page #9

**Problem: The digital display is frozen or changing rapidly.**
Certain devices such as Electronic (Digital) Ballasts and Ozone generators produce a huge amount of electronic “noise”. If you are operating these other devices, locate them as far away from the controller as possible.
Connection examples

For indoor growing, Cooling devices connect to the Temperature receptacle.

Heaters can be connected to the Temperature receptacle OR the CO2 receptacle.

Mushroom farmers need to reduce CO2 levels. Connect your ventilation fan to the CO2 receptacle to remove excess CO2.

Plants require increased CO2 levels. Connect your 120 volt compressed CO2 solenoid / regulator assembly to the CO2 receptacle.

Plants require increased CO2 levels. Connect your 120 volt CO2 generator to the CO2 receptacle.

The optional 12 volt DC adapter allows the CTC-1 to be coordinated with other controllers like the EVC-2.

A quick look at the CTC-1...

LCD displays temperature and CO2 PPM levels

12 button keypad to change settings

Optional 12 VDC CO2 disable jack

(2) 120V receptacles to connect cooling or heating device and CO2 equipment up to 15-amps.

Photocell allows CO2 use only during the Day OR 24-hours.

Built-in fan “samples” the air for quicker and more accurate measurements.

15-amp @ 120V Circuit breaker

Heavy-duty Power switch
Installing the CTC-1

1) Locate a suitable location. The unit should be at plant height. The photocell on the front of the unit can operate with indirect to full light.

2) First secure the provided bracket to the wall. Next snap the controller into place and tighten the (2) thumb-screws top & bottom.

**NOTE:** Make sure the thumb-screws are in place before attempting to use the controller. The sensor is VERY fragile… treat it with care.

3) The internal CO2 PPM sensor and the temperature probe will measure the level of CO2 and the temperature of the air. The built-in fan ensures accurate readings by sampling the air flowing through the enclosure.

4) The unit requires a 120 volt, 15-amp power supply. Plug the power cable into a standard Nema 5-15 wall outlet.

5) The devices that will be controlled must be 120 volt & 15-amps or less.

6) If you are using a cooling or heating device, connect the device’s power cable into the receptacle marked “Temperature”.

7) Connect the CO2 device to the receptacle marked CO2 Device. You can operate a CO2 generator, a compressed CO2 regulator or ventilation device. (For mushroom farming)

8) Turn the power switch to the ON position and you are ready to go.

**NOTE:** Pressing any of the buttons on the CTC-1 activates, “wakes-up” the keypad and displays “Keypad Test O.K.” Then you can select the desired setpoint button to change the setting.

**NOTE:** In order for the CTC-1 to work correctly for YOUR application, you may need to first check and change some factory setpoints. Refer to Operating the CTC-1 section of this manual.

There are 12 buttons on the unit that control all the functions.

- **CO2 Setpoint:** Press this button for 1 second to display and change the current CO2 Part-Per-Million setting Factory setpoint 1250 PPM.

Analog Output

An additional built-in function on the CTC-1 is the ability to drive (2) linear analog devices such as a chart recorder or any other device that requires a 0-10 volt or 0-20 mA signal. There are 2 separate outputs for both the temperature and CO2.

The outputs can be configured for mA or mV by positioning (2) blue jumpers on the control PC board.

*Note: The factory setting is for mA output.

The wires connected to the analog terminals can be routed out of the unit through the blank receptacle covers on the left side of the unit.

**NOTE:** Make sure the unit is unplugged before attempting to open the unit. Connections to the analog outputs must be made correctly.
Computer interface

Advanced user and researchers will appreciate the CTC-1's ability to be connected to a computer. The computer interface and software allows the user direct access to the CTC-1 control board. Once connected via a RS 232 / 9-pin serial connection, the software will chart and record the temperature or CO2 levels. The current measurements are displayed clearly on your laptop or computer. Users can also change settings and recalibrate the unit from the software. You can even select an automatic SAVE function to save the results directly to an Excel spreadsheet.

The optional interface kit consists of a 9-pin interface cable that is hard-wired into the control board, a CD ROM and instructions.

NOTE: Make sure the unit is unplugged before attempting to open the unit. Connections to the computer interface must be made correctly.

Installing the CTC-1 (Continued)

- **CO2 Dead-band**: Press this button for 1 second to display and change the current CO2 Dead-band. *Factory setpoint 50 PPM.*
- **CO2 Calibrate**: Press this button for 1 second to re-calibrate the CO2 sensor. *Refer to the Calibration section. Factory setpoint 375 PPM.*
- **Temp Setpoint**: Press this button for 1 second to display and change the current Temperature setting. *Factory setpoint 78°F.*
- **Temp Dead-band**: Press this button for 1 second to display the current temperature Dead-band setting. *Factory setpoint 2°F.*
- **Temp Calibrate**: Press this button for 1 second to display the re-calibrate the temperature sensor. *Refer to the Calibration section. Factory setpoint 1250 PPM.*
- **Relay Mode**: Press this button for 1 second to select one of the three available modes of operation. *Refer to the “Operating the CTC-1” section of this manual. Factory setpoint Mode #1.*
- **Restore Factory Settings**: Press this button for 1 second to restore the originally programmed factory setpoints. This will revert the unit to its original state.
- **UP**: Press this button to display to increase the setting.
- **Down**: Press this button to display to increase the setting.
- **Enter/Reset**: Press this button accept and enter the new setpoint.
- **Clear / Back**: Pressing this button will cancel the previous selection.
Operating the CTC-1

The CTC-1 has been designed to be simple to set-up and “program”. Separate buttons for each setting make changes easy.

Selecting the desired Relay Mode: There are (3) available modes of operation that control the function of the control relays and the CO2 and Temperature control devices connected to the unit.

* Most hydroponic, indoor or greenhouse operators.
Mode #1 / Temperature COOLING and CO2 Increase mode.
The temperature control will over-ride the CO2 control.

* Indoor mushroom farmers.
Mode #2 / Temperature HEATING and CO2 Decrease mode.
Both the temperature and CO2 output are controlled independently.

* Optional mode for greenhouse operators.
Mode #3 / Temperature HEATING and CO2 Increase mode.
Both the temperature and CO2 output are controlled independently.

**NOTE:** The relay mode will affect how the Temperature and CO2 receptacles will operate. If mode #1 is selected, the CO2 receptacle will be disabled when the Temperature receptacle is turned ON.

To change the Relay Mode setting: press the Relay Mode button on the keypad. “Keypad Test OK” is displayed. Pressing it again will display the current setpoint. Use the Up or Down button to change the setting. Press Enter to accept the new setpoint. To cancel and go back, press the Clear / Back button.

Factory setpoint Mode #1.

To select the photocell operation: The photocell can be used to ensure the CO2 is only activated during the “day”. (Agricultural users) But the photocell can also be bypassed for people growing mushrooms. (Mushroom farmers select relay mode #2 to decrease CO2 levels)

Moving the 2 position switch to the 24-hour mode will force the CO2 controller to function 24-hours a day regardless of whether it is light out or not. People using the CTC-1 for agricultural purposes other than mushroom farming should set the photocell selector switch to the Daytime setting.

Factory setpoint Daytime.

Connecting to external controllers

For some agricultural users, it is best to coordinate the Temperature and CO2 functions. This is done when the temperature control receptacle is connected to an exhaust fan and the CO2 is connected to a compressed CO2 system. If the functions are not coordinated, the exhaust fan can pull the compressed CO2 out of the growing area as fast as it is being released which is very wasteful and expensive.

The CTC-1 already has the ability to coordinate the two functions by selecting mode #1 which will disable the CO2 function whenever the exhaust fan is activated. However some users may choose to interface an additional device to the CTC-1. For instance, the EVC-2 which has separate Day and Night temperature setpoints. Connecting the EVC-2 to the CTC-1 gives you Day / Night temp control with coordinated CO2 use during the day.

The CO2 Disable function is an optional feature which allows the user to connect a low-voltage 12 volt DC power supply to the CTC-1. The power supply (shown below) is plugged into a device like the EVC-2 Temperature receptacle. When the Temperature receptacle on the EVC-2 is turned ON, the 12-vdc power supply connected to the side of the CTC-1 will disable the CO2 receptacle on the CTC-1 while the temperature control device is activated reducing the amount of CO2 being used.
Calibrating the CTC-1 (Continued)

Temperature Calibration: Under normal conditions, the Temperature sensor should not need to be calibrated. If the unit appears to not be measuring the temperature levels correctly or if the unit has been dropped or jarred severely, you can recalibrate the unit.

1) You will need another accurate temperature measurement device to compare the reading to. Place the units side by side.
2) To activate the automatic calibration sequence, press the Temp Calibration button, the display will read “Keypad Test OK”.
3) Pressing the Temp Calibration button again will display the “new” temperature calibration point. (Factory set at 75°F)
4) The calibration level can be changed by using the UP and Down buttons. Change the display to the correct calibration point.
5) Pressing Enter will start the calibration process. The process is almost instantaneous. When complete, the display returns to normal operation. The unit can now be returned to service.

Warning!!!

Some electronic devices such as Electronic (Digital) HID ballasts and Ozone generators produce large amounts of electronic noise, which can affect other equipment. The Sentinel line of controllers and timers have been “hardened” by using shielded cable and shielded enclosures however… some EBs do not have proper shielding. For best results it is highly recommended to position your controller at least 8 ft away from any EBs (Electronic Ballasts). It is also a good idea to route the cables going from the EB to the HID lamp away from the controller and the remote temperature probe cable attached to the controller.

Operating the CTC-1 (Continued)

Setting the CO2 level: Setting the desired CO2 PPM level is simple. Most users can use the factory setpoint of 1250 PPM. To change the setting, press the CO2 Setpoint button on the keypad. “Keypad Test OK” is displayed. Pressing it again will display the current setpoint. Use the Up or Down button to change the setting. Press Enter to accept the new setpoint. To cancel and go back, press the Clear / Back button. Factory setpoint 1250 PPM.

NOTE: The built-in photocell has a 30 second time delay. The photocell can be used to control the CO2 function. See page 6

Setting the Temperature level: Setting the desired Temperature level is simple. Most users can use the factory setpoint of 78°F. To change the setting, press the Temp Setpoint button on the keypad. “Keypad Test OK” is displayed. Pressing it again will display the current setpoint. Use the Up or Down button to change the setting. Press Enter to accept the new setpoint. To cancel and go back, press the Clear / Back button. Factory setpoint 78°F.

Setting the CO2 Dead-band: The CO2 Dead-band can be set by the user. The dead-band is the range of measurement that the control will allow the CO2 level to vary by. The higher the setting, the less often the CO2 device will turn ON and OFF. Lower settings will cause the CO2 device to turn ON and OFF more frequently. Press the CO2 Dead-band button on the keypad. “Keypad Test OK” is displayed. Pressing it again will display the current setpoint. Use the Up or Down buttons to change the display to the desired mode. Press Enter to accept the change. Factory setpoint 50 PPM

Setting the Temperature Dead-band: The Temperature Dead-band can be set by the user. The dead-band is the range of measurement that the control will allow the Temp level to vary by. The higher the setting, the less often the temperature control device will turn ON and OFF. Lower settings will cause the Temp device to turn ON and OFF more frequently. Press the Temp Dead-band button on the keypad. “Keypad Test OK” is displayed. Pressing it again will display the current setpoint. Use the Up or Down buttons to change the display to the desired mode. Press Enter to accept the change. Factory setpoint 2°F.
**Operating the CTC-1 (Continued)**

*NOTE:* The CO₂ and Temp Dead-band settings should only be changed by experienced users. Dead-band is the maximum amount of deviation from the setpoint allowed. For example, the factory default for the Temp Dead-band is 2°F. Let's assume the unit is set to Cool mode, and the temperature is set at 78°F. When the temperature rises to 78°F, the cooling device will be activated. With a 2 degree F “dead-band”, the cooling device will continue to run until the temperature is reduced by 2 degrees, down to 76 degrees. Setting the Dead-band lower than 2 degrees will control the temperature more accurately, but it may also cause the cooling device to start and stop too often. Increasing the hysteresis will stop the rapid cycling On/Off of the control output.

**Restoring factory settings:** If the user wants to quickly return the unit to the original settings, they can use the Restore Factory Settings button. Press the **Restore Factory Settings** button on the keypad. “Keypad Test OK” is displayed. Pressing it again will display the “Restore Factory” message. Press **Enter** to accept the change or the **Clear / Back** button to exit.

**Calibrating the CTC-1**

Even though the CTC-1 has been designed for many years of trouble-free operation, occasional the need arises to re-calibrate the sensors. Recalibrating the unit will restore the sensors ability to accurately measure the Temperature and CO₂ levels.

*NOTE:* Recalibration of the CO₂ sensor must be completed away from all animals and people OUTDOORS! Follow the procedure exactly.

**CO₂ Calibration:** The CO₂ sensor has a lifetime of over 10 years. Over the life of the sensor however, dust and other contaminants can accumulate on the inner optical surfaces of the sensor cell itself. To adjust for the contamination, the calibration feature is provided. If the unit appears to not be measuring the CO₂ levels correctly or if the unit has been dropped or jarred severely, you should recalibrate the unit.

1) Locate an area outdoors away from people, animals and high traffic areas. The unit must be shaded and NOT placed in direct sunlight.

2) Plug in the unit in and allow the unit to warm up for approximately 20 minutes. Note: Waiting longer (1+ hours) provides more accurate calibration.

3) Try not to exhale or breath on the unit while activating the calibration function. Once activated, leave the unit alone for 10 minutes.

4) To activate the automatic calibration sequence, press the **CO₂ Calibration** button, the display will read “Keypad Test OK”.

5) Pressing the **CO₂ Calibration** button again will display the “new” ambient CO₂ level. (Factory set at Ambient 375 PPM) If the unit will be calibrated in an area of high vehicular traffic, or near people, a slightly higher calibration point should be selected.

6) The calibration level can be changed by using the **UP** and **Down** buttons. Only change this setting if you are sure the background (ambient) CO₂ level is higher then normal atmospheric levels of 375 PPM. If you live in a highly populated city, you may increase the calibration level to 400-475 PPM.

7) Pressing **Enter** will start the calibration process. LEAVE THE UNIT ALONE! The process takes about 7-10 minutes. When complete, the display returns to normal operation.

8) The unit can now be returned to service.